SCIENCE

NEW SERIES
VOL. XLVI. No. 1193

FRIDAY, NOVEMBER 9, 1917

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $5.00

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE STRUCTURE OF ATOMS AND THE EVOLUTION OF THE ELEMENTS AS RELATED TO THE COMPOSITION OF THE NUCLEI OF ATOMS.

II

The elements have thus been found to fall into two series: first, those of even, and second, those of odd, atomic number. Now, if the theory presented for the structure of the atoms is correct, then it should be possible to find some difference between the two series with reference to their properties. Since, however, this part of the theory refers specifically to the structure of the nuclei of the atoms, and not to the arrangement of the external or non-nuclear electrons, it is evident that this difference should not be found in those properties due to the external electrons, that is in the chemical or physical properties. On the other hand, the difference should be found in any properties inherent in the nucleus, and the only property, aside from mass and weight (from which our system has been developed), which has thus far been discovered, and which is due to the structure of the nucleus of the atom, is that of atomic stability. Thus, if an atom loses outer electrons, it does not change its atomic number, and therefore does not change to another element, but if it loses nuclear electrons, it does change its nucleus, its atomic number is changed, and the atom is said to disintegrate—that is, it changes into the atom of another element.

Our theory therefore indicates a probable general difference in stability between the even- and odd-numbered elements. A

consideration of the radioactive elements indicates that those which have odd atomic numbers have either shorter periods, or else are at present unknown. Now unfortunately there is no known method of testing the stability of the elements of low atomic number, but it might seem, at first thought, that the more stable atoms should be the more abundantly formed, and to a certain extent this is undoubtedly true. If then, at the stage of evolution represented by the solar system, or by the earth, it is found that the even-numbered elements are more abundant than the odd, as seems to be the case, then it might be assumed that the even-numbered elements are on the whole the more stable. However, there is at least one other factor than stability which must be considered in this connection. The formula of the even-numbered elements has been shown to be nHe'. Now, since that for the odd-numbered elements is $nHe' + H_3'$ it is evident that if the supply of the H_3' needed by the elements was relatively small at the time of their formation, not so much material would go into this system, and this would be true whether the H_3' represents three atoms of hydrogen or one atom of some other element.[3]

In studying the relative abundance of the elements the ideal method would be to sample one or more solar systems at the desired stage of evolution, and to make a quantitative analysis for all of the 92 elements of the ordinary system. Since this is evidently impossible, even in the case of the earth, it might be considered that sufficiently good data could be obtained from the earth's crust, or the lithosphere. However, the part of the crust to which we have access is relatively so thin, and has been subjected to such far-reaching magmatic differentiation, and to such extensive solubility effects, that it seems improbable that the surface of the earth at all truly represents its composition as a whole. The meteorites, on the other hand, show much less evidence of differentiative effects, and undoubtedly represent more truly the average composition of our planetary system. At least it might seem proper to assume that the meteorites would

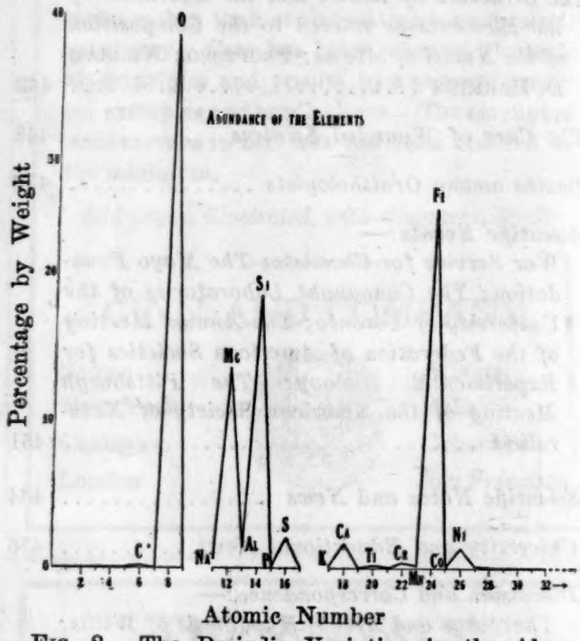

Fig. 2. The Periodic Variation in the Abundance of the Elements as the result of Atomic Evolution. The data are given for 125 stone meteorites, but the relations are true for meteorites in general. Note that *ten* elements of even atomic number make up 97.59 per cent. of the meteorites, and *seven* odd-numbered elements, 2.41 per cent., or 100 per cent. in all. Elements of atomic number greater than 29 are present only in traces.

[3] With regard to the latter alternative, it is at least remarkable that the H_3 occurs 11 times in the system for the first 27 elements, while H_2 and H each occur only once, and it may also be mentioned that Fabry and Buisson have by interference methods determined the atomic weight of nebulium to be 2.7, and this they think indicates that its real atomic weight is 3. Also, Campbell has found that in the nebula N. G. C. Index 418, situated in the southern part of the constellation of Orion, the nebulium spectrum is found farther from the interior than that of helium, while the hydrogen spectrum extends out to a much greater distance still. This, he thinks, indicates that the atomic weight of nebulium lies between the values for hydrogen (1) and helium (4).

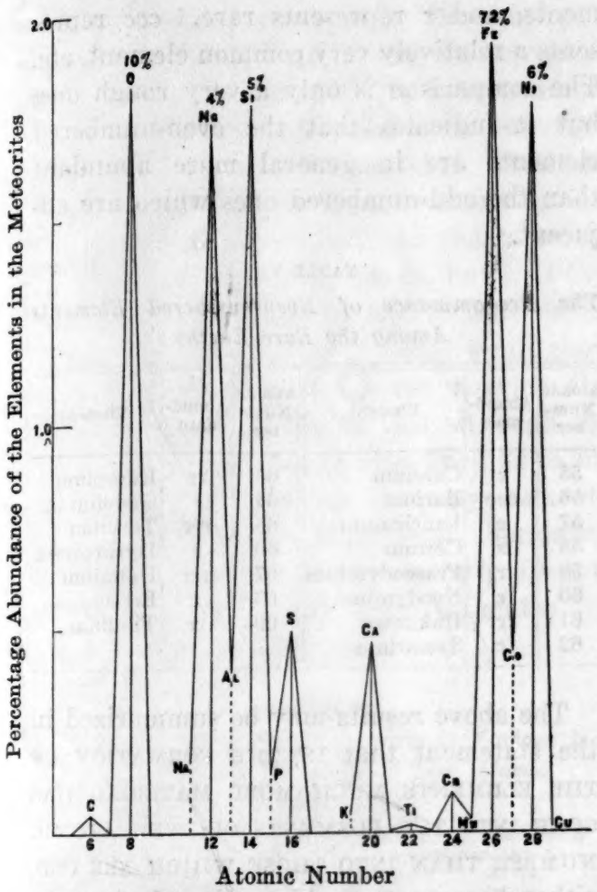

FIG. 3. The abundance of the elements in the meteorites. Every even-numbered element is more abundant than the two adjacent odd-numbered elements.

not exhibit any special fondness for the even-numbered elements in comparison with the odd, or, vice versa, any more than the earth or the sun as a whole, at least not unless there is an important difference between these two systems of elements, which is just what it is desired to prove. A study of the compilations made by Farrington, by Merrill, and by other workers of analyses of meteorites, has given some very interesting results.

The results show that in either the stone or the iron meteorites the even-numbered elements are very much more abundant than the odd. Thus in the iron meteorites there are about 127 times more atoms of even atomic number than of odd, while in the stone meteorites the even-numbered elements are about 47 times more abundant. If we average the 125 stone and 318 iron meteorites given by Farrington, it is found that the weight percentage is 98.78 for the even and 1.22 for the odd-numbered elements, or the even-numbered elements are about 81 times more abundant.

If we consider these same meteorites, 443 in all, and representing all of the different classes, it is found that the first seven elements in order of abundance are iron, oxygen, silicon, magnesium, calcium, nickel and sulphur, and *not only do all of these elements have even atomic numbers, but in addition they make up 98.6 per cent. of the material of the meteorites.*

Table IV. gives the average composition of these meteorites. The numbers before the symbols are the atomic numbers, and

TABLE IV

Average Composition of Meteorites Arranged According to the Periodic System

Series	Group 1 Odd	Group 2 Even	Group 3 Odd	Group 4 Even	Group 5 Odd	Group 6 Even	Group 7 Odd	Group 8		
								Even	Odd	Even
2				6C 0.04%		8O 10.10%				
3	11Na 2.17%	12Mg 3.80%	13Al 0.39%	14Si 5.20%	15P 0.14%	16S 0.49%				
4	19K 0.04%	20Ca 0.46%		22Ti 0.01%		24Cr 0.09%	25Mn 0.03%	26Fe 72.06%	27Co 0.44%	28Ni 6.50%
	29Cu 0.01%									

those below give the percentages of the elements. *It will be noted that the even-numbered elements are in every case more abundant than the* ADJACENT *odd-numbered elements.* The helium group elements form no chemical compounds, and are all gases, so they could not be expected to remain in large quantities in meteorites. For this reason, and also because the data are not available, the helium or zero group is omitted from the table.

From this table it will be seen that while *high percentages,* as great as 72 per cent. in one case, *are common among the even-numbered elements,* the highest percentage for any odd-numbered element is less than one per cent. (0.39 for aluminium).

If we now turn to the composition of the earth, it is found that the atoms of even atomic number are about ten times more abundant in the surface of the earth than those which are odd. Also, all of the five unknown elements, eka-cæsium, eka-manganese 1, eka-manganese 2 (dwi-manganese), eka-iodine and eka-neodymium, have odd atomic numbers. It should be mentioned in this connection, however, that there is some doubt as to whether element 72 has been discovered.

While the relative abundance of the elements in the lithosphere is undoubtedly much affected by differentiation, there is one group whose members are so closely similar in chemical and physical properties, that they would be much less affected in this way than any other elements. These are the rare earths. The only difficulty in this connection is that of making an accurate estimate of the relative abundance. In this the writer has been assisted by Professors C. James and C. W. Balke, but any errors in the estimate should not be attributed to them. In the table, which includes beside the rare earths a number of elements adjacent to them, the letter *c* indicates common in comparison with the adjacent elements, and *r* represents rare. *ccc* represents a relatively very common element, etc. The comparison is only a very rough one, but it indicates that the even-numbered elements are in general more abundant than the odd-numbered ones which are adjacent.

TABLE V

The Predominance of Even-numbered Elements Among the Rare Earths

Atomic Number	Abundance	Element	Atomic Number	Abundance	Element
55	c	Caesium	63	rr	Europium
56	ccc	Barium	64	r	Gadolinium
57	c	Lanthanum	65	rrr	Terbium
58	cc	Cerium	66	r	Dysprosium
59	r	Praseodymium	67	rrr	Holmium
60	c	Neodymium	68	r	Erbium
61	rrr	Unknown	69	rr	Thulium
62	c	Samarium			

The above results may be summarized in the statement that IN THE FORMATION OF THE ELEMENTS MUCH MORE MATERIAL HAS GONE INTO THE ELEMENTS OF EVEN ATOMIC NUMBER THAN INTO THOSE WHICH ARE ODD, either because the odd-numbered elements are the less stable, or because some constituent essential to their formation was not sufficiently abundant, or as the result of both causes.

It is easy to see, too, that in the evolution of the elements, the elements of low atomic number and low atomic weight have been formed almost exclusively, and this indicates either that the lighter atoms are more stable than those which are heavier, or else that the lighter atoms were the first to get the material, and their stability was at least sufficient to hold it.

It is possible that the heavier atoms have been formed in larger amounts than now exist, and that their abundance has been reduced by atomic disintegration. It is of course evident that the radio-active elements are now disintegrating, but the radio-active series of elements includes only those of atomic number 81 (thallium) to 92

(uranium); and lead (82) is the end of the series as now recognized. For our purposes, however, we still call the atoms of atomic numbers 1 to 29 the lighter atoms, and from 30 to 92 the heavier atoms. The following table indicates that when defined in this way the lighter atoms are extremely more abundant. In the table the weight percentages are given, but it is evident that if these same figures were calculated to atomic percentages they would show even smaller values for the heavier elements. The table shows that although the heavy atoms have been so defined as to include more than twice as many elements as the light atoms, their total abundance is so small as to be relatively insignificant. The data are taken from estimates by Clarke and by Farrington.

TABLE VI

Illustrating the Large Proportion in Various Materials of the Elements of Low Atomic Numbers (1–29)

Material	Percentage of Elements with Atomic Numbers 1–29	30–92
Meteorites as a whole.	99.99	0.01
Stone meteorites	99.98	0.02
Iron meteorites	100.00	0.0
Igneous rocks	99.85	0.15
Shale	99.95	0.05
Sandstone	99.95	0.05
Lithosphere	99.85	0.15

It is thus seen that SO FAR AS THE ABUNDANCE OF THE ELEMENTS IS CONCERNED, THE SYSTEM PLAYS OUT AT ABOUT ELEMENT 30, and it is of great interest to note that it is just at this point that other remarkable changes occur. For example, up to this point nearly all of the atomic weights on the oxygen basis are very close to whole numbers. On the other hand the elements with higher atomic numbers (28 to 92) have atomic weights which are no closer to whole numbers than if they were wholly accidental. Also, just at this point the atomic weights cease to be those predicted by the helium-hydrogen theory of structure presented in this paper (Table III.). This does not mean, however, that the helium-hydrogen system fails at this point, but that the deviations in the atomic weights for the elements of higher number are produced by some complicating factor. This would be most easily explained on the hypothesis that isotopes are abundant among the elements of atomic number higher than 28. Such a hypothesis should, of course, be confirmed experimentally before it is given much credence. It is quite possible, too, that radioactive disintegrations have proceeded downward in the system as far as iron, and that iron is the end of a disintegration series. If this were true, it would explain the great abundance of iron in the meteorites. In whatever way we may average the analyses of the materials found in meteorites or on earth, the two most striking elements from the standpoint of abundance are oxygen, the most abundant of the elements of very low atomic number (8), and iron, which has the highest atomic number (26) of any very abundant element.

The fact that the elements which have heavy atoms (atomic numbers 30 to 92, or more than two thirds of the elements) have been formed in such minute amounts would be very much more striking to us if we lived on an earth with a perfectly uniform composition. On such an earth, formed without any segregation, it is probable that almost none of these elements would have been discovered. Quite certainly such elements as gold, silver, iodine and arsenic would not be known, and copper, lead, zinc and tin, if known at all, would be in the form of extremely small specimens.

In this connection it may be remembered that the earth has the highest density of any of the planets. The data given in Table V. show that in the meteorites, which

vary in density from about 2.5 for the lightest stone, to more than eight for the heaviest iron meteorites, the increase in density is not brought about by an increase in the abundance of what have been defined as the heavy atoms, but only by a shift in the relative abundance of the light atoms. Thus in the less dense stone meteorites the average atomic percentage of oxygen, atomic weight 16, is 54.7 per cent., while that of iron, atomic weight 55.84, is 10.6 per cent. In the more dense iron meteorites, on the other hand, the percentage of oxygen is practically negligible, while that of iron has risen to 90.6 per cent.[4] A study of the densities of the elements and their compounds shows that the abundance of the elements does not seem to be related to this property. In fact the only apparent relation is to the atomic number, which indicates that the abundance relations are the result of evolution, that is of the factors involved in the formation and disintegration of the atoms.

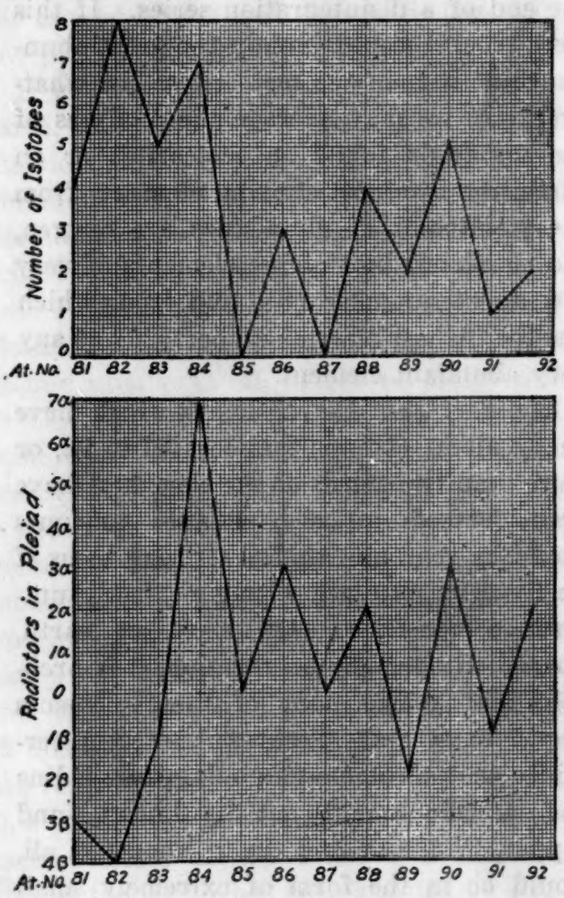

FIG. 4.

[4] For nickel, atomic weight 58.68, it is 8.5 per cent.

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UNIVERSITY OF CHICAGO

NOTE: Since the presentation of the above paper it has been pointed out by Norris F. Hall that both the *isotopic complexity*, and the *number* of *predominant radiation* of the radio-active elements show a sharp alternation with increasing atomic number, and that this alternation is strictly in accord with the general hydrogen helium theory of atomic structure. The variation of these properties is illustrated in Figure 4 and it will be seen that the general form of these figures is the same as that of Figures 2 and 3 which represent the abundance of the elements.

THE CARE OF WOUNDED SOLDIERS

MANY matters of importance touching upon American cooperative effort and activity along medical and surgical lines were developed during the past week in Chicago, when the general medical board and the State activities committee of the medical section of the Council of National Defense held stated meetings in conjunction with the annual meeting of the Clinical Congress of Surgeons of North America. Secretary of the Navy Daniels discussed the activities of the Navy directed toward the moral and intellectual welfare of the naval personnel, and Surgeon Generals Gorgas, Braisted, and Blue spoke for the Army, Navy, and Public Health Service, outlining the medical work in these respective branches.

Surgeon General Gorgas at a meeting of the general medical board, which preceded the clinical congress, outlined the efforts now being directed toward meeting medical needs on the fields of battle, at home, and also in

transporting permanently disabled United States soldiers from abroad. Only those men will be returned home who are permanently disabled or who have a contemplated convalescence of six months. The experience of the allies, it was stated, indicates that about 10 per cent. of the wounded are permanently disabled.

On their return home the American soldiers will receive not only adequate medical treatment but will also be afforded the extra facilities of special hospitals built with the idea in view of rehabilitating physically and reeducating industrially our incapacitated soldiers. It is also contemplated to devote special hospitals in France to the treatment of special diseases, such, for example, as tuberculosis or injuries of the head, brain, eyes, ears, or face.

General Gorgas announced the fundamental policy of adhering to the Manual of 1914, which provides that the military hospitals shall consist of three general divisions, medicine, surgery, and laboratories. Under this type of organization the specialties will have full scope and yet come under adequate medical or surgical control and direction.

The Clinical Congress of Surgeons of North America is an organization founded seven years ago by Dr. Franklin H. Martin, of the advisory commission of the Council of National Defense, of Chicago. Surgical demonstrations were held at 25 important Chicago hospitals and programs were arranged almost exclusively along medico-military lines.

France was represented by Colonel C. Dercle and England by Colonel T. H. Goodwin, R. A. M. C. Sir Berkeley Moynihan presented the activities of the British Army and Major George W. Crile, M. R. C., detailed the American medical activities in France.

After Colonels E. L. Munson and F. F. Russell had outlined the work of the Surgeon General's office in organizing the medical officers' training camps and the various military laboratories, Sir Berkeley Moynihan contributed an exposition of wound treatment in the British Army. He explained in detail the search for satisfactory antiseptic drugs and ventured the novel axiom that wounds did best when merely carefully cleaned, put at rest, and kept free from contact with any drug or antiseptic. His address attracted much attention because it was the first authoritative denial of the universal efficacy of the now famous Carrel-Dakin technique of wound treatment.

Major G. W. Crile, in discussing the address of Sir Berkeley, corroborated all that he said. Short addresses were made by Drs. Edward Martin, E. H. Dunham, and W. E. Lee, all of Philadelphia. By means of a moving-picture demonstration and the detailing of experimental and clinical data, they showed how much could be done for clean wound healing by the new antiseptic, Dichloramine-T, which is being investigated under instructions from the Surgeon General's office. Dr. William O'Neill Sherman, who presented evidence of the efficacy of the Dakin-Carrel method of wound treatment, closed the Tuesday evening program.

In addition to the usual committee reports, the meeting of the general medical board was livened by two instructive reports from Sir Berkeley and Major Crile. Sir Berkeley showed the remarkable efficiency developed by the Medical Corps of the British forces, and this despite the fact that 96 per cent. of the doctors were civilian physicians at the outbreak of the war. This efficiency is attributable, among other things, to the two important factors of "surgical teamwork" and surgical consultants. The principle of surgical teamwork was learned in the United States, said Sir Berkeley, and the principle of consultants (these consultants are picked from the leading surgical minds of Britain) was evolved from the necessity of having some one authoritative group to direct and correlate medical activities consecutively from the field dressing stations back to the base hospital.

Major Crile outlined this plan for the so-called clinical sector, which in brief is made up of a team of men, selected preferably from a university or hospital where they have previously worked in unison, and now distributed among the dressing, field, evacuation, and

base hospitals of a given sector at the front. The object of such a unit is to secure at all times uniformity and continuity of oversight in the treatment of the wounded from the time of the first field dressing to the completion of convalescence.

At the meetings of the States activities committee resolutions were introduced and acted upon in regard to the universal training of young men above 19 for a period of six months, for the rehabilitation of rejected physically defective conscripts, and for the prophylaxis, control, and treatment of venereal disease.

DEATHS AMONG ORNITHOLOGISTS

The *Auk* publishes obituary notices of several ornithologists who have died recently from which we take the following facts:

Dr. Emil August Goeldi died suddenly at Bern, Switzerland, July 5, 1917, in the fifty-eighth year of his age. He was born at Ennetbühl, Canton of St. Gall, Switzerland, August 28, 1859. He studied at the Zoological Station at Naples and was assistant of Professor Ernst Haeckel at the Zoological Institute at Jena. In 1884 he went to Brazil and became associated with the museum in Rio de Janeiro. After the fall of the Emperor Dom Pedro II., in 1889, he retired from this position and lived for four years in the state of Rio de Janeiro. About 1894 he founded the museum in Para, now known as the Museu Goeldi. This institution which comprised not only a museum but also a zoological garden and a botanical garden was taken over by the state a few years later and Goeldi then became honorary director. In 1905, after twenty years of life in the tropics, he returned to Switzerland and took up his residence in Bern where, since 1908, he has been professor of zoology in the Cantonal University. He visited the United States in August, 1907, at the time of the meeting of the Seventh International Congress of Zoology in Boston. Dr. Goeldi has published a number of papers in English, German and Portuguese on various branches of zoology, but chiefly on mammals, birds and fishes.

Alfred John North died of heart failure at Sydney, Australia, May 6, 1917, only five months after the death of his former chief and associate, Dr. E. P. Ramsay. He was born in North Melbourne, Australia, June 11, 1855, and was educated in the public and grammar schools of Melbourne. Later he worked at the jeweler's trade for some years. At an early age he developed an interest in ornithology which was stimulated by visits to the National Museum at Melbourne and by the officers of this institution, Sir Frederick McCoy the director, and John Leadbeater in charge of ornithology. In 1878 he corresponded with Ramsay and eight years later went to Sidney to arrange the Ramsay collection of birds and the collection of eggs of the Australian Museum. After spending several months at this task he was asked to prepare the "Descriptive Catalogue of the Nests and Eggs of Birds found Breeding in Australia and Tasmania" which was published in 1889. About this time he was appointed an assistant to the curator, Dr. Ramsay, and in 1891 was made ornithologist of the museum, a position which he retained until his death. He has published many papers on the birds of Australia.

Rev. William Rogers Lord died in Dover, Mass., February 2, 1916, in the sixty-ninth year of his age. He was born in Boston, Mass., May 6, 1847. He graduated from Amherst College with the degree of A.B., in 1875 and from the Union Theological Seminary, in New York, in 1878, and had held pastorates in the East and in the West.

Mr. Lord was deeply interested in birds and especially in popularizing bird study and bird protection.

Dr. Bert Heald Bailey died at Cedar Rapids, Iowa, June 22, 1917. He was born at Farley, Iowa, May 2, 1875. Dr. Bailey graduated from Coe College in 1897 and received his master's degree from the same institution in 1900. In 1900 he also completed his course and received an M.D. degree from Rush Medical College, Chicago. In September, 1900, he became professor of zoology and curator of the Museum of Coe College, a position which he held at the time of his death.

He published a small volume entitled "200 Wild Birds of Iowa" in 1906, and was the author of numerous short papers and notes on mammals and birds which appeared from time to time in the *Proceedings* of the Iowa Acad- of Science and in *The Auk*. In addition, many valuable notes contributed by him appear in Anderson's "Birds of Iowa."

Francis Windle died at his home in West Chester, Pa., on February 24, 1917, in his seventy-second year. Mr. Windle was born in West Marlboro, Chester county, Pa. He lived most of his life in West Chester, having received his education in the schools of his native county and at the University of Michigan, at which latter place he took his law course. Owing to poor health Mr. Windle found it necessary to give up the practise of law and seek outdoor employment. He secured a position with one of the extensive nurseries at West Chester. Here his wide knowledge of botany acquired during his frequent outing trips, which constituted his chief recreation for years, proved a valuable asset. During his recreational activities his time was about equally divided between his study and observation of plants and birds, with the result that he became skilled in both botany and field ornithology.

For several years Mr. Windle taught biology at Darlington Seminary, West Chester, and also did some teaching at the State Normal School in the same place.

For about eleven years prior to his death he was connected with the Bureau of Zoology, Department of Agriculture of Pennsylvania, with headquarters at Harrisburg. He became assistant orchard inspector for the eastern end of Pennsylvania, and while acting in this capacity was made a member of the Chestnut Blight Commission, and later of the White Pine Blister Rust Commission. The duties of these positions took him all over the eastern end of the state and kept him out of doors where he could indulge his passion for botany and ornithology. He was a member of the Philadelphia Botanical Club and of the Delaware Valley Ornithological Club and kept constantly in touch with men in these fields.

SCIENTIFIC EVENTS

WAR SERVICE FOR CHEMISTS[1]

FRANCE and England freely acknowledge that they greatly decreased their efficiency by sending their scientific men to the trenches. Although they have since withdrawn most of those still alive and are now using them in special service, the dearth of technically trained men has been and is severely felt.

Secretary of War Baker, aware of this fact, is carrying out the full spirit of the *selective* draft, and specially trained men, so far as needed, are being assigned to the war service which they are trained to render.

More than others among scientific men, trained chemists have been needed for war purposes by both the Army and the Navy.

Fortunately, the American Chemical Society and the Bureau of Mines, acting cooperatively, foreseeing this need, took first a census of American chemists and later compiled from all data available a list of those enlisted. From this list of chemists actually in the Army and the Navy a large number have been selected for special fitness and have been already assigned. Many more, undoubtedly, will be so assigned, and if the present demand keeps up, it may later be necessary to ask for special enlistment for chemical work. That time has not yet arrived.

At present any chemist not required by law to enter chemical war service who enters voluntarily keeps one chemist in the ranks and deprives the chemical industries of his own service as well. A number of chemists have been commissioned, but these are picked men of special attainments and specific experience. The majority will serve as privates or noncommissioned officers until such time as they are found to deserve promotion.

Don't ask to be assigned to chemical work until you are actually in the camp. Camp assignment must be made before your name will be submitted to the War Department.

Don't send in your name, even for consideration for such service, if exemption is to be

[1] From *The Journal of Industrial and Engineering Chemistry*.

asked for or while exemption claims are pending. It leads to endless confusion.

Don't try to deprive another chemist actually in the Army of his opportunity to render chemical service by yourself seeking such service, *until called*. The industries which supply the Army and Navy with the sinews of war need trained chemists and are being seriously handicapped by the depletion of their chemical personnel.

Don't write to anyone in Washington to aid you in a claim for exemption. Even if they wished to do so, they are quite properly powerless for the law delegates exemption to the Local and District Boards.

Do send me your name, address, military and camp assignment when actually sworn in (not before). If you have not already filed details of your age, training and experience, send this also at the same time.

Charles L. Parsons,
Secretary

American Chemical Society,
Box 505,
Washington, D. C.

THE MAYO FOUNDATION

At the meeting of the board of regents of the University of Minnesota held on September 13, the regents adopted the following resolution thanking the Drs. Mayo for their gift establishing the Mayo Foundation for medical investigation and research:

Whereas, Dr. William J. Mayo and Dr. Chas. H. Mayo, of Rochester, Minnesota, have given the sum of $1,650,344.79 to the University of Minnesota for the establishment of a fund to be known as the "Mayo Foundation for Medical Education and Research," and,

Whereas, This gift has been duly accepted by unanimous action of the board of regents,

Therefore, be it Resolved, That the board of regents records its profound sense of gratitude to the donors. The gift is unique in the annals of American education. It represents the lofty purposes of two of the most distinguished citizens of our commonwealth. They believe that this money has come from the people and that it should be returned to the people. It has been the sole aim of the donors to provide a fund which would be of permanent benefit to the state of Minnesota and to mankind as a whole. They have wisely and appropriately provided that the income of the fund shall be used for medical education and research. American universities should be encouraged in the prosecution of an educational policy which aims to develop investigators and scientists of the first rank. One clear function of a true university is to make actual contributions to various fields of knowledge. This new foundation, therefore, relates itself very intimately to the realization of our highest educational aims. Both for the gift itself and for the genuine impetus which it will impart to scholarly investigation in this university, we desire to convey to the donors our sincere appreciation.

THE CONNAUGHT LABORATORIES OF THE UNIVERSITY OF TORONTO

The Connaught Laboratories of the University of Toronto, and a farm of fifty acres, were formally presented by Colonel Albert Gooderham, to the University of Toronto and at the same time officially opened by the Governor General, the Duke of Devonshire, on October 25. The value of the gift is about seventy-five thousand dollars. The laboratories are to be used for the purpose of research in preventive medicine and for the production of serums and vaccines. Sir William Hearst, the premier of Ontario, at the opening, announced that a grant of seventy-five thousand dollars would be authorized at the next session of the legislature, to establish a research foundation in preventive medicine. The income from this and also from an additional twenty-five thousand dollars, will be used for research only, the laboratories being self-supporting. This is the first endowment of research in preventive medicine in Canada. In connection with the official opening of these laboratories, a lecture was delivered in Convocation Hall, on the same evening by Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, on the "War activities of the Rockefeller Institute." A distinguished audience, including the Governor General and the Lieutenant Governor, attended this most interesting and able lecture.

THE ANNUAL MEETING OF THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

The annual meeting of the Federation of American Societies for Experimental Biology

occurs this year at the University of Minnesota in Minneapolis. The scientific program covers the three days of December 27, 28 and 29. The Local Committee is planning attractive features of general interest, including a trip to Rochester, that center of medical and surgical activities which the war conditions have raised to a plane of paramount importance. The four societies of the federation are the American Physiological Society, the American Society of Biological Chemists, the American Society for Pharmacology and Experimental Therapeutics, and the American Society for Experimental Pathology. Many members of these societies are engaged in scientific work in support of our government in the great war struggle. The general secretary hopes that the scientific program will strongly reflect this present activity and that the meeting will be one of unusual interest and enthusiasm. The members of the societies are urged to make vigorous efforts to attend and to contribute to the program. The fact that the meetings of the American Association of Anatomists and the American Zoological Society occur at the same time and place lends the strong appeal of mutual and cooperative interest which every member of the federation will find it difficult to resist.

CHARLES W. GREENE,
General Secretary of the Federation.
COLUMBIA, MISSOURI,
October 25, 1917

THE PITTSBURGH MEETING OF THE AMERICAN SOCIETY OF NATURALISTS

THE American Society of Naturalists, in affiliation with Section F of the American Association for the Advancement of Science and the Botanical Society of America, will hold its thirty-fifth annual meeting at Pittsburgh, under the auspices of the University of Pittsburgh, beginning Tuesday, January 1, 1918.

There will be a smoker for Biologists on Saturday evening, December 29.

The Botanical Society of America will place the genetical papers of its program on Monday morning, December 31, and in the afternoon of the same day will present an invitation program including the presidential address of R. A. Harper.

Section F of the American Association for the Advancement of Science will have on Monday morning the address of the retiring vice-president, G. H. Parker, and in the afternoon a symposium on "The contributions of zoology to human welfare."

By this arrangement there will be sessions of interest to the members of the American Society of Naturalists on the day preceding the meetings of the society.

The American Society of Naturalists will offer for Tuesday morning, January 1, a program of invitation papers.

The program for Tuesday afternoon will be a symposium on "Factors of organic evolution."

The Naturalists' dinner, in which members of the affiliated societies are invited to participate, will be held on the evening of Tuesday. At the close of the dinner George H. Shull will give his presidential address, "The genotype and its environment."

As the result of an apparently growing desire on the part of members of the American Society of Naturalists to contribute papers, the Program Committee will this year receive titles for a program to begin on Wednesday morning, January 2. It is desired that the papers be short and it should be remembered that the interests of the Naturalists are primarily on problems of organic evolution. The papers on this program will in general be arranged in order of the receipt of the titles, except that papers on similar subjects may be grouped. Titles with estimated length of delivery and statement of lantern or chart requirements must be in the hands of the secretary by December 1.

Nominations for membership must be sent to the Secretary not later than December 1 in order that the Executive Committee may give them due consideration before the meeting. Blank forms for nominations may be obtained from the secretary.

Headquarters of the Naturalists will be at the Monongahela House, Smithfield and Water Streets. Members are advised to make early reservations.

Single rooms ..... $1.50; with bath, $2.00
Double rooms ..... $2.00; with bath, $3.00

Other hotels recommended by the local committee:

		Minimum rate for single room
Anderson	Penn and Federal	$1.50
Chatham	423 Penn Ave.	1.50
Colonial Annex	Sixth and Penn	1.00
Fort Pitt	Tenth and Penn	2.00
Henry	417 Fifth Ave.	2.00
Lamont	Spahr and Adler	1.00
Lorraine	Highland and Rodman	1.00
Motor Square	Center and Beatty	1.00
Newell	343 Fifth Ave.	1.50
Schenley	Bigelow Blvd. and 5th	2.00
Seventh Ave.	Seventh and Liberty	1.50
William Penn	Wm. Penn Place	2.50
Yoder	1112 Forbes St.	.50

Bradley M. Davis,
University of Pennsylvania, *Secretary*
Philadelphia

SCIENTIFIC NOTES AND NEWS

Dr. L. I. Bailey was elected president of the American Pomological Society at the recent Boston meeting.

Dr. John Charles Hessler, professor of chemistry in the James Millikin University at Decatur, Illinois, has been elected to the presidency of the Illinois State Academy of Science.

At the Chicago meeting of the American College of Surgeons the following were elected fellows: Surgeon General Rupert Blue, United States Public Health Service; Surgeon General William C. Gorgas, United States Army; Surgeon General William C. Braisted, United States Navy; Colonel T. H. Goodwin, British Medical Corps; Colonel C. Dercle, French Medical Corps; Sir Berkeley Moynihan, Leeds, England.

Dr. Louis B. Wilson, of the Mayo Foundation of the University of Minnesota, has been appointed director of the foundation.

Frank C. Baker, zoological investigator of the New York State College of Forestry, at Syracuse, formerly acting director of the Chicago Academy of Sciences, has been appointed curator of the university museum at the University of Illinois, where his work will begin within a couple of months.

A testimonial banquet was given by the Physicians' Club of Chicago, in honor of Dr. Frank Billings, at the Auditorium Hotel, on November 1. Dr. Augustus O'Neill acted as toastmaster. A silver loving cup was presented to Dr. Billings on behalf of the Physicians' Club.

A peerage of the United Kingdom has been conferred upon the Right Honorable Sir Francis Hopwood, vice-chairman of the Development Commission, and a member of the General Board and Executive Committee of the National Physical Laboratory.

President Poincaré has conferred the Legion of Honor upon Dr. John Cadman, C.M.G., professor of mining in the University of Birmingham, in recognition of valuable services rendered by him in the cause of the allies.

Professor I. Bandi has been placed in charge of the newly opened institution at Naples for the production of therapeutic serums and vaccines as a center for research in hygiene and biology, with special regard to colonial conditions.

P. F. Walker, dean of the engineering school and formerly head of the department of mechanical engineering at the University of Kansas, has been granted an indefinite leave of absence to enter the army. He has received a commission as Lieutenant Colonel and is stationed at Camp Cody, N. M. Professor George C. Shaad has temporarily assumed the duties of dean and Professor Frederick H. Sibley has been made head of the department of mechanical engineering.

James H. Bonner, professor of forestry in the Montana State University, has been appointed captain in the engineers' section of the officers' reserve corps.

Victor K. La Mer, formerly chemist at the Carnegie Institution, Cold Spring Harbor, Long Island, has received a commission of first lieutenant in the Sanitary Corps.

President William Jasper Kerr, of the Oregon Agricultural College, has been appointed head of the increased agricultural production campaign and chairman of the Food Committee of the State Council of Defense.

PROFESSOR H. S. PRATT, of Haverford College, assisted by Frank C. Baker, zoological investigator of the New York State College of Forestry, made during the past summer a study of the parasitic worms of Oneida Lake fishes. This work was made by cooperation between the U. S. Bureau of Fishes and the New York State College of Forestry at Syracuse, and was a part of the fish survey which has been carried on there for the past three years.

PROFESSOR CALVIN H. KAUFFMAN, curator of the Cryptogamic Herbarium, and professor in the department of botany of the University of Michigan, has left for Colorado where he will spend the year gathering and selecting mushrooms in order to experiment on them for certain malignant diseases which affect crops. Professor Kauffman was granted a year's leave of absence in order that he might work on these plant diseases for the United States government.

DR. WILLIAM C. FARABEE, director of the University of Pennsylvania Museum, who recently returned from a two years' exploring trip to the Amazon River, is now engaged in installing the exhibits he collected. Thousands of rare specimens are being made ready and when finished they will occupy the entire floor of the museum. The collection, which will be opened to the public early in November, promises to be the finest of its kind in the world. In the absence of Director Gordon, Dr. Farabee is acting director of the museum.

DR. FRANK CARNEY, professor of geology and geography at Denison University, has resigned to enter the employment of The National Refining Company of Cleveland, Ohio.

L. M. TOLMAN, for seventeen years connected with the Bureau of Chemistry, U. S. Department of Agriculture, and for the last three years chief of the central food and drug inspection district of that bureau, has resigned to become chief chemist of Wilson & Co., Chicago, to have charge of their control and research work.

SIR MAURICE FITZMAURICE, C.M.G., has been appointed to fill the vacancy on the advisory council of the Committee of the Privy Council for Scientific and Industrial Research of Great Britain, caused by the retirement, by rotation, of Mr. W. Duddell, C.B.E., F.R.S.

A PERUVIAN Medical Commission, which will tour the United States inspecting medical schools and hospitals, began its work in Baltimore, October 14, and from there went to Philadelphia and New York. The commission is composed of Professor Dr. Guillermo Gastaneta and Drs. E. Campodonico and R. Asplazu. The object of the commission is to secure information for the reorganization of the medical schools of Peru in accordance with American standards.

DR. HENRY C. SHERMAN, professor of food chemistry in Columbia University, who has recently returned from service in Petrograd as a member of the scientific division of the American Red Cross Mission to Russia, spoke of the work of the mission in Russia at Hastings-on-Hudson, New York.

PROFESSOR L. H. BAILEY, of Cornell University, will present a paper on the evening of November 12 before the Society for the Promotion of Agricultural Science in Washington on "Permanent Agriculture and Democracy (suggested by the situation in China)."

PROFESSOR SIMEON E. BALDWIN, of Yale University, was reelected president of the Connecticut Academy of Arts and Sciences at its annual meeting on October 18. At this meeting Professor Baldwin read a paper on "The growth of law during the past year." Dr. Olive Day and Dr. George F. Eaton were elected vice presidents.

THE Harvey Society lectures will be given at the New York Academy of Medicine, as follows: Nov. 10, Dr. Carl L. Alsberg, Washington, D. C., "Current food problems"; Nov. 24, Dr. Linsly R. Williams, "The medical problem of the war"; Dec. 8, Professor Aldred S. Warthin, Ann Arbor, "The new pathology of syphilis."

MR. FISHER, the British minister for education, presided, on October 31, at a meeting in London, which was addressed by Mr. Waldorf Astor, on "Health problems and a state ministry of health." Mr. Kingsley Wood, of the

London County Council, and others took part in the discussion.

Dr. George D. Hubbard, head of the department of geology of Oberlin College, will address the annual meeting of the Central Association of Teachers of Science and Mathematics at Columbus, Ohio, which will be held from November 30 to December 1, on "Why should geography be taught in the high schools?" Dr. Hubbard has recently been retained in Toledo in connection with certain problems of physiography and geography involved in the riparian case in litigation in which agricultural and fishing industries clashed.

Dr. R. H. Ward, of Troy, N. Y., known for his work in microscopy and from 1869 to 1892 professor of botany in the Renssellaer Polytechnic Institute, died on October 29, aged eighty years.

Sir William James Herschel, discoverer and developer of the system of identification by fingerprints, died on October 24. Sir William was born in 1833. He was the grandson of Sir William Herschel, the English astronomer, and the son of Sir John Frederick William Herschel, whom he succeeded in the baronetcy in 1871.

The death is announced of Mr. Charles Latham, at Glasgow. Mr. Latham was the first Dixon professor of mining in Glasgow University.

William Robert Sykes, the inventor of the lock-and-block system of railway signalling, died on October 2, at the age of seventy-seven years.

Under an agreement between the executors of the estate of the late James Buchanan Brady and his heirs, most of the estate, estimated at $3,000,000, is now available for the New York Hospital, and makes possible the establishment of the James Buchanan Brady Foundation of Urology, which is in accordance with the testator's plans. Dr. Oswald S. Lowsley, who was named by Mr. Brady as director, has the plans of the foundation in charge.

The Robert Dawson Evans Memorial for Clinical Research and Preventive Medicine of the Massachusetts Homeopathic Hospital will receive about $1,000,000, as residuary legatee of the estate of Maria Antoinette Evans.

The forty-fifth annual convention of the American Public Health Association opened in Washington on October 18. Herbert C. Hoover, director of the United States Food Administration, addressed the convention at its first general session. The program for the afternoon called for a joint session of the association with the American Social Hygiene Association, the Baltimore Medical Society and the Maryland Society for Social Hygiene. A symposium on easily preventable disease control in the army, the navy and the civilian community was given by Colonel F. F. Russell, U. S. A.; Surgeon R. C. Holcomb, U. S. N.; Raymond B. Fosdick, chairman of the commission on training camp activities; Assistant Surgeon General J. W. Kerr, of the Federal Public Health Service, and Surgeon William H. Frost, director of the Red Cross Sanitary Service.

The Civil Service Commission of the State of New York announces examinations for the State Department of Health for a physiological chemist at a salary of $1,500; for a laboratory assistant in chemistry at a salary of $720 to $1,200 and for a laboratory assistant in bacteriology at a salary of $720 to $1,200. These positions are open to non-residents and to citizens of other countries except those at war with the United States, and in the first two positions a degree from a college maintaining a standard satisfactory to the commission or an equivalent education is required.

UNIVERSITY AND EDUCATIONAL NEWS

Columbia University, New York University and the Presbyterian Hospital are beneficiaries in the will of Kate Collins Browne, who died on August 19. They will share the residue of the estate after half a million dollars is distributed in bequests.

YALE University has acquired by purchase another entire city block in the center of New Haven.

THE enrollment in the College of Medicine of the Universtiy of Cincinnati shows an increase of about 40 per cent. over last year. The enrollment in 1916 was 102 compared with 143 for the year 1917–18.

IN the Oregon Agricultural College Adolph Zeifle has been made dean of the newly created school of pharmacy; Miss Ava B. Milam dean of the school of home economics, and E. K. Soper, head of the department of mines at the University of Idaho, has been appointed dean of the school of mines to fill the vacancy made by the resignation of Dean H. M. Parks to head the Oregon Bureau of Mines and Geology.

PROFESSOR HOTCHKISS, of the department of business education of the University of Minnesota, has been made chief of the department of economics during the absence of Professor Durand.

PROFESSOR C. C. PALMER, of the College of Agriculture of the State University of Minnesota, has been appointed head of the department of bacteriology, physiology and hygiene, at the Delaware College, Newark, Del.

DR. ALBERT C. HERRE, for several years past professor of geography and agriculture in the Bellingham, Washington, State Normal School, has recently been appointed head of the department of biology in the same institution.

EBEN H. TOOLE, recently of the Kansas Agricultural College, Manhattan, Kansas, has been appointed to succeed Professor G. N. Hoffer as assistant professor of plant pathology and physiology, at Purdue University. Professor Hoffer has been transferred to the Agricultural Experiment Station of Purdue.

DR. C. C. FORSAITH, instructor in botany in Dartmouth College, has been appointed instructor in wood technology in the New York State College of Forestry.

E. A. REID, for the past two years instructor in electrical engineering at Minnesota, has resigned to accept a similar position at the University of Illinois.

PROFESSOR CLARENCE A. MORROW, formerly professor of chemistry in the Nebraska Wesleyan University, has been elected assistant professor of agricultural biochemistry in the University of Minnesota.

MRS. J. A. NYSWANDER has been appointed assistant professor of mathematics at the University of Nevada, to take the place of her husband, who has been called to government service.

DISCUSSION AND CORRESPONDENCE

THE "AGE AND AREA" HYPOTHESIS OF WILLIS

THE "Age and Area" hypothesis of Willis, recently discussed and endorsed by Professor De Vries in SCIENCE,[1] states that "the area occupied by any given species (of plants) at any given time in any given country in which there occur no well-marked barriers depends upon the age of that species in that country." The older the species is, in other words, the wider is its range. If confirmed, this hypothesis would be of the greatest scientific importance, for not only would it discredit the efficacy of natural selection—the point chiefly emphasized by its author and Professor De Vries—but, by enabling us to identify with certainty the most widespread types as the most ancient ones, in any given region or in the world as a whole, it would also clear up a host of vexed questions in plant geography and plant phylogeny. Certain objections to the hypothesis appear to be so great, however, as to cast doubt upon its universal applicability; and a careful study of the floras of Ceylon and New Zealand, the regions with which Professor Willis has chiefly worked, serves to emphasize the complexity of the whole problem involved.

Factors other than age evidently share in determining the area occupied by a species.

[1] De Vries, H., "The distribution of endemic species in New Zealand," SCIENCE, N. S., Vol. XLV., No. 1173, pp. 641–642, June 22, 1917.

Barriers of various sorts certainly do exist almost everywhere and effectively limit the extent to which a species may be dispersed. We have reason to believe that many types are as widespread as they can ever be and that no increase in age, other factors remaining constant, will widen their ranges. In fact, evidence from fossils shows that certain species and genera occupy to-day smaller areas than they formerly did.

Factors inherent in the plant itself are also bound to influence the extent of its distribution. Types which are hardy and able to thrive under a wide range of conditions will obviously spread farther and faster that those which are sensitive or specialized. The growth habit of a plant, too, seems to be very important in determining distribution, trees usually occupying small ranges, shrubs wider ones and herbs the widest of all. This may be observed in almost any flora and is very noticeable in those of Ceylon and New Zealand, where the endemic species, necessarily of limited dispersal, are predominantly trees and shrubs; the non-endemic, widespread ones, predominantly herbs. The data as to relative commonness of species in Ceylon given in Trimen's "Flora," the authority used by Professor Willis, also show clearly that the herbs are much commoner and more widely dispersed than are the woody plants.

The theory that the most widespread types are the oldest meets with further difficulties from some of its implications. The fact which we have just mentioned, that species of herbs tend universally to have much wider ranges than those of shrubs or trees, a circumstance long ago noted and emphasized by De Candolle, must mean, if we follow Professor Willis, that the herbaceous element in the angiospermous vegetation of the globe is more ancient than the woody element. Against this conclusion there are serious objections, and it is at present maintained by few botanists or geologists. In its interpretation of endemic types the hypothesis is also open to objection, since it regards endemic species and genera in all cases as of recent origin, the newest element in their respective floras. There is much evidence, however, from taxonomy and paleobotany, that in many cases endemics are relicts of types once much more widely spread which have disappeared from all regions save one. Such endemics are evidently ancient rather than recently acquired members of a flora.

This point involves the necessary corollary to his hypothesis which Professor Willis brings forward when he states[2] that the "dying out" of a species is a rather rare event, usually requiring some profound geological or climatic change. This belief in the essential permanency of types necessarily leads Professor Willis to the view that species or genera which are isolated taxonomically and without near relatives have become so not through the extinction of intermediate and connecting forms, but by a single step, a view demanding belief in the frequency and permanence of wide mutations. If we look again at the fossil record, however, we see such an overwhelming array of extinct types that it is hard to attribute their extermination in every case to a cataclysmic disturbance. This difficulty increases when we examine the flora of any such isolated region as Ceylon or New Zealand. If Professor Willis's hypothesis is correct, the original invaders of each of these islands—its oldest plant inhabitants—should now be the most widespread and common members of its flora, in contrast to the endemic forms which have sprung from them and are thus more rare and local. If we look at the flora of Ceylon, however, we find that there are no less than 63 genera of dicotyledons alone, 8 per cent. of the whole, which, though not endemic in Ceylon, are represented only by *endemic* species. In New Zealand 90 non-endemic genera of dicotyledons, or 43 per cent. of the whole, are similarly represented only by endemic species. In these cases, where in each genus is the parent species or group of species, the original invader, which has supposedly given rise to all these endemic forms and which should now be more common than any of them? It certainly

[2] Willis, J. C., "The evolution of species in Ceylon, with reference to the dying out of species," *Annals of Botany*, Vol. XXX., 1916, p. 1.

has died out in some way, since it no longer exists in the island.

A further objection to the hypothesis lies in its particular application to the flora of New Zealand. On the basis of the soundings, Professor Willis believes that the land bridge over which came the original plant population of the islands entered at about the center of the chain. He presumably refers to the strip of shoal water running northwesterly from New Zealand toward Australia, on which stands Lord Howe Island. On the assumption that all the original invaders entered at this central point and spread north and south, and that in doing so they followed the rule of "age and area," Professor Willis makes and verifies a series of predictions as to the disposition of the flora to-day. His whole argument hinges on the existence of an original central point of entry and dispersal. It neglects entirely the evidence that a large and characteristic element of the New Zealand flora entered the islands *not* from Australasia on the west, but from the antarctic regions to the south. Hooker, Wallace and Cheeseman, the foremost authorities on antarctic floras, state their belief that, even if there was never a complete land bridge from the southern extremity of New Zealand to the antarctic continent, there was at least a considerable southward extension of New Zealand at one time (for which there is also evidence on the ocean bottom) over which the "antarctic types" came north and entered it. If the southern tip of New Zealand was thus also a center of entrance and dispersal for a large floral element, Professor Willis's observations are far from supporting his hypothesis. He notes particularly the scarcity of endemic species at both the north and south extremities of the islands, and points to this fact as convincing confirmation of his views, since (assuming a single central point of dispersal) the extremities would be populated last and would have produced as yet but few endemics. But assuming a second point of entry, at the southern extremity of the islands, we should expect to find there to-day, if the "age and area" hypothesis is true, a decided bunching of endemic species. Either the hypothesis is incorrect, or the commonly accepted theory as to the dispersal of the antarctic floras is erroneous.

Against Professor Willis's hypothesis are therefore to be urged (1) that it disregards important factors other than age which determine area of dispersal; (2) that the conclusions which it necessarily implies as to the antiquity of certain plant types are opposed by a preponderance of evidence; (3) that, contrary to its expressed assumption, many species are becoming rarer and are "dying out"; and (4) that it fails to explain the distribution of the New Zealand flora.

There are doubtless a large number of species which are still extending their ranges and for which Professor Willis's hypothesis holds good. Many persons will also sympathize with his chief contention, that natural selection can not fully explain the origin of endemic species and genera; and a few will share his belief in the frequency and importance of very wide mutations. The problems involved in the origin, dispersal and extinction of species, however, are evidently far too complex to be covered by any single inclusive hypothesis like that of "age and area."

E. W. SINNOTT
CONNECTICUT AGRICULTURAL COLLEGE

ERASMUS DARWIN AND BENJAMIN FRANKLIN

TO THE EDITOR OF SCIENCE: Referring to the Notes on Erasmus Darwin and Benjamin Franklin in SCIENCE of September 21, last, on page 291 near the bottom of Column 1 is the remark that

> Even as far back as 1772 some one was puzzling over the idea of making a phonograph.

He quotes Dr. Darwin as saying:

> I have heard of somebody that attempted to make a speaking machine, pray was there any truth in such reports?

The "speaking machine" referred to was not a phonograph for reproducing speech, but a machine which could talk of itself. There was an effort to make such a machine, which the writer of the article quoted seems not to have heard of. This effort was continued

down to the time of the invention of the phonograph, and somewhat beyond that time. One Joseph Faber began to work on an idea of this sort in 1815, and in 1841 had the machine so far finished that it was exhibited to the king of Bavaria, as stated in an article from the *London Times* of February 12, 1880, which is now lying before me. This machine was exhibited in America in the seventies and eighties and I heard it talk and ask and answer questions put by the audience. Its speech was very mechanical, without inflection or emphasis. It was worked by an attendant with a keyboard and bellows. An ivory reed whose pitch could be varied formed the vocal chords. The cavity of the mouth could be changed in shape and size by the keys of the keyboard. A tongue and lips of rubber formed the consonants. A windmill in the throat rolled the R's and a tube was attached to the nose when it spoke French! It could also speak German and English. It is not probable that any one had thought of a phonograph in the sense in which we use the term as early as 1772. Knowledge of electricity was not sufficiently advanced at that time.

W. C. Peckham

QUOTATIONS

THE PHYSIQUE OF RECRUITS

In the summer of 1916 the Board of Scientific Studies was established under the ægis of the Royal Society to serve as a means of placing knowledge in the possession of scientific and technical societies at the disposal of government departments. At the first general meeting of this board in July, 1916, the urgency of a physical survey of the nation, to discover whether or not there existed definite evidence of physical deterioration, was discussed. Emphasis was laid by various speakers on the fact that an Interdepartmental Committee had reported in 1904 that such a survey was necessary. Nothing, however, had been done. The mobilization of a national army had provided an opportunity, as well as a need, for such a survey.

The Board of Scientific Studies requested the Royal Anthropological Institute to report on the desirability and possibility of such a survey. The institute having reported that such a survey was both desirable and possible, the board formed an Anthropological Survey Sub-committee to consider the manner in which such an investigation could best be carried out. This sub-committee has not yet reported to the Board of Scientific Studies, but we understand that it is seeking for the means of carrying out such a survey through the government departments which have directly to do with the health and physique of the nation: the Recruiting Authority—now the Ministry of National Service—the Local Government Board and the Board of Education. Representatives of these departments have joined the Anthropological Survey Sub-committee, and it is hoped that a practical scheme may be formulated at an early date.

Meanwhile American anthropologists have stolen a march on their British colleagues. When the United States entered the war the National Research Council was at once created to serve the same purpose as our Board of Scientific Studies. Its Anthropological Committee, formed to advise in the selection, standardization and examination of recruits, has already issued its report and recommendations. It proposes that six of the sixteen great concentration camps should be selected for an anthropological survey—two in the Eastern, two in the Middle, and two in the Western States—and that special men who had been trained to use exactly the same anthropometrical methods at the National Museum at Washington, should be dispatched to carry out a survey of the men in the selected camps. The points for investigation have been reduced to a minimum, namely, standing and sitting heights, three dimensions of the head, two of the face, two of the chest, with precise records of the color of skin, eyes and hair. The statistical staff of the Prudential Insurance Company of America has undertaken to deal with the data collected, while the Smithsonian Institution will facilitate the publication of results.

Although the intentions of the British committee are more wide-reaching and aim at as-

certaining the condition of all elements in the population, it is to be hoped that the observations taken in Britain and America will be capable of direct comparison—for, beyond doubt, the bulk of the population of the United States has a British ancestry.

SCIENTIFIC BOOKS

Mental Conflicts and Misconduct. By WILLIAM HEALY. Boston, Little, Brown & Company, 1917. Pp. 330.

Like earlier studies from the psychopathic institute attached to the Chicago Juvenile Court, this work emphasizes the need of painstaking inquiry into the experience and inner life of the individual delinquent, if the treatment given him is to be in any sense remedial. The present book illustrates the author's method of "mental analysis," a process somewhat akin to the "psychoanalysis" of Freud, though not making the same pretensions to penetrate to the very depths of the individual's make-up, and not operating with dreams, symbols or association tests, but by a straightforward conversational approach, in which the subject is sympathetically asked to tell "if anything is worrying him." This line of approach is especially indicated when the subject shows signs of an "inner urge" towards misdoing, without deriving any material benefit, but only painful consequences, from his misdoing. In such cases, there is reason to suspect a "mental conflict," which may be discovered by the analysis and then cleared up by proper handling, with the happy result that the misconduct ceases.

The mental conflict discovered by analysis is often of the following stamp. A young child, previously a good child, and often of good intelligence and from a good home, is incited by some bad boy or girl or older person to sex practices, and very often at the same time to stealing or truancy. The child rejects the sex practices, though often obsessed by the thought of them or by the bad words used in connection with them, but begins to steal or run away from home. The author interprets this to mean that an "inner urge," primarily directed towards sex behavior but prevented from finding an outlet there, escapes through the channel of stealing, etc., which has become accidentally associated in the child's mind with the sex matter. From such causes, quite a career of delinquency may be entered upon by children who are fundamentally normal and healthy-minded.

As judged from a series of two thousand juvenile recidivists, the per cent. of cases of delinquency in which mental conflict of this general type enters as a causative factor is about seven—more rather than less. It is not the "rough" type of juvenile offender that is here in question, nor the mentally defective. Usually the cases show good mentality and good social qualities. They are not moody and "shut-in," nor egocentric, nor, indeed, of any peculiar mental or temperamental type (unless, as is possible from the tests given, the imagery or mental representation of these individuals is unusually active and vivid). Heredity does not appear as an important factor; but it is rather the social or mental environment of the child that generates the conflict. Specially important in this regard is the lack of confidential relations between the child and his parents, leading the child to keep his difficulties to himself, when a frank discussion of them with a sympathetic adult would resolve the conflict.

The treatment appropriate to this species of delinquents is by no means punishment—an entirely superficial and notably unsuccessful reaction—but, first of all, mental analysis directed to discovering the genesis of the misconduct, and then "reeducation," including the giving of suitable information and the development of an intelligent attitude towards the causes of conflict; further, the establishment of confidential relations between the delinquent child and an adult adviser, and often the removal of features of the environment that suggest misconduct.

Psychologically, the author's case-material is of great interest, and the interpretation given, in terms of mental conflict, is likewise of considerable interest, though it does not

appear to fit all the cases equally well. To the reviewer, at least, a rather different "mental mechanism" would seem to fit the case histories better. In particular, the association between sex behavior and such other forms of misconduct as stealing and truancy is perhaps not so purely accidental and extraneous as the author assumes; for all of these forms of bad conduct typify for the child that life of "badness" which, perhaps because of its rebellion against authority and restraint, makes a certain appeal even to the "good" child. That is to say that the child does not resort to stealing as an outlet for dammed-up energy primarily directed towards sex behavior, but that, being incited to "badness" in several directions, and responding in some measure to the incitation, he follows the line that he is able to understand and follow with some success, leaving aside what he is not ripe for, though perhaps being mystified and obsessed by this latter.

R. S. Woodworth

Columbia University

Telephone Apparatus. By George D. Shepardson, Professor of Electrical Engineering, University of Minnesota. D. Appleton & Co. 1917. 337 pages, 115 illustrations.

Considering the marvelous rapidity of growth of telephony and the extent to which the telephone permeates the daily life of the modern business man, especially in America, where there is an average of one telephone to each ten persons, it is surprising how little is generally known concerning the history, construction or mode of operation of that wonderful device. This book presents an introduction to the development and theory of telephony for the educated classes of the public in general, and particularly for those engaged in telephonic operation or manufacture.

The book contains sixteen chapters, relating respectively to the following subjects: Introduction, Sound, Speech sounds, Telephone receivers, Telephone-receiver investigations, Telephone transmitters, Telephone-transmitter investigations, Signaling devices, Design of non-polarized signaling apparatus, Permanent magnets and polarized apparatus, Design of polarized apparatus, Electromotive forces and currents, Principles of induction coils, Uses of induction coils in telephony, Condensers in telephony, Protective devices. The treatment is directly descriptive, abundantly illustrated by pictures and diagrams of the apparatus. The mathematical analysis is nearly all collected into the appendices at the end of the book, so that a non-mathematical reader can peruse all the chapters with very few interruptions.

The book deals mainly with telephonic apparatus, and the principles underlying its operation. Circuit arrangements are given relatively minor consideration, and radio-telephony is not included. A good set of indexes at the end of the volume greatly assists the reader.

A noteworthy feature of the book is the large number of collateral references indicated in footnotes throughout the text. The collection and collation of so much historical and technical material represents a large amount of labor. The insertion of this subordinate material makes the work of great value as a reference book to telephonists and students of telephony. Probably no other text-book on telephony in the English language contains such a wealth of electro-technical reference material. A. E. K.

SPECIAL ARTICLES

ANESTHESIA AND RESPIRATION[1]

There is much uncertainty as to the effect of anesthetics upon respiration. Some writers hold that anesthetics decrease respiration while others take the opposite view.[2] To clear up this confusion appears to be a necessary step toward a satisfactory theory of anesthesia.

[1] Preliminary communication.

[2] *Cf.* Höber, R., "Physik. Chem. der Zelle und der Gewebe," Ch. 8 und 9, 1914. Czapek, F., *Biochem. der Pflanzen*, Vol. I., S. 195 ff., 1913. Ewart, A. J., *Annals of Bot.*, 12: 415, 1898. Tashiro, S. and Adams, H. S., *Amer. Jour. of Physiol.*, 33 xxxviii, 1914. Appleman, C. O., *Amer. Jour. of Bot.*, Vol. 3, No. 5, May, 1916.

The writer has recently been able to develop a method[3] for the measurement of minute amounts of carbon dioxide. The application of this method to the present problem has yielded interesting results.

The experiments were made by measuring the change in the hydrogen-ion concentration of sea-water produced by the respiration of the marine alga, *Laminaria*. This was conveniently done by the addition of a suitable indicator (phenosulphonephthalein) to the sea-water and comparing the color of the solution with the colors of a series of buffer solutions of known hydrogen-ion concentration (containing the same concentration of indicator).

When the concentration of the anesthetic was so great as to cause considerable dilution of the sea water, concentrated sea water was added until the mixture had the same electrical conductivity as sea-water. When an anesthetic (as formaldehyde) showed an unusually high acidity, the free acid was first neutralized with sodium carbonate. This is allowable for the purposes of the present investigation, as its only effect would be to make the amount of CO_2 produced appear somewhat less than was actually the case. By selection of sea-water from different carboys, sea-water could be obtained for controls that had the same PH value as that of the sea-water containing the anesthetic.

The fronds were cut up into pieces about two inches long, the cutting being reduced to a minimum, since it is known that an increase of respiration may follow injury.[4] Preliminary experiments, in which uncut smaller fronds were used for comparison with the cut fronds, showed that the change in the respiration due to the cutting was negligible (especially since the cut pieces were usually left about half an hour in sea-water before being used).

Each piece of tissue was inserted into a Pyrex glass tube, closed by fusion at one end, a piece of paraffined rubber tubing being attached to the open end. Sea-water was then added, the solutions being the same temperature as the bath. The temperature of the bath was always kept at 16° C. Black-enamelled collapsible tin tubes served to exclude light from the tubes. After the sea-water bathing the tissue had been changed several times, a given amount of sea-water was added to the tube and a small bubble of air was included in order to serve as a stirrer (it was found to be preferable to paraffined glass beads). After the tube had been kept in the dark at 16° C. for a definite period it was removed from the bath and stirred by inverting the tube a few times. The clamp was then opened and the solution rapidly poured into an empty tube, to which the same number of drops of indicator had been added as was added to the buffer solutions. The solution was then mixed with the indicator in the manner just described and the color was then compared with buffer solutions of a known PH value (containing the same concentration of indicator). The decrease in PH as observed with a constant source of light ("Daylight" lamp) served to measure the amount of CO_2 produced by respiration.

In order to be sure that no acid except CO_2 was being given off by the plant a stream of hydrogen was allowed to bubble through the solution which had been made acid by respiration in order to see whether it came back to the same PH value as at the start.[5] This was the case in every instance.

Each piece of material was used for a number of periods (always of the same length) in sea-water (which was changed at the end of each period) until the rate of respiration had become practically constant. Then several of the pieces were used as controls while others were placed in sea-water containing the anesthetic (the solutions were always renewed at the end of each period).

Experiments were carried on with sea-water containing the following substances: .1 per cent. chloral hydrate, .1 per cent. novocain, 1

[3] Haas, A. R., SCIENCE, N. S., 44: 105, 1916.

[4] *Cf.* Richards, H. M., *Annals of Bot.*, 10: 551, 1896; *ibid.*, 11: 29, 1897.

[5] In very strong concentrations (alcohol 24 per cent. or acetone 17 per cent.) a little pigment may be extracted from the plant. In this case it may be necessary to reject the figures for the first period (or of the first two periods).

per cent. ether, 0.1 per cent. caffeine, ethyl bromide (approximately saturated), 3.2 per cent. formaldehyde, .8 per cent. formaldehyde, .3 per cent. chloroform, .05 per cent. chloroform, 0.1 per cent. acetone, 0.51 per cent. acetone, 17.4 per cent. acetone, 24.2 per cent. ethyl alchohol, 16.1 per cent. ethyl alcohol, 10 per cent. ethyl alcohol, 5 per cent. ethyl alcohol, 2 per cent. ethyl alcohol and 1 per cent. ethyl alcohol.

It was found that whenever the concentration of anesthetic is sufficiently strong to produce any measurable result, the initial effect is always an increase of respiration which may either remain approximately constant over a large number of periods and then gradually decline or the increased rate of respiration may fall very rapidly below the normal when the concentrations of anesthetic are too great.

It is very noteworthy that in no case was the respiration of *Laminaria* observed to fall below the normal when exposed to sea-water containing anesthetic except after prolonged exposure to high concentrations which produced death.

SUMMARY

When *Laminaria* is exposed to the action of anesthetics (in sufficient concentration to produce any result) there is an increase in respiration. This may be followed by a decrease if the reagent is sufficiently toxic. No decrease is observed with low concentrations which are not toxic.

These facts contradict the theory of Verworn that anesthesia is a kind of asphyxia, for his view is based upon the assumption that anesthetics decrease respiration.

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AN OUTLINE OF THE LIFE HISTORY OF THE CLOTHES MOTH, TINEOLA BISELLIELLA

Some four years ago the writer was asked by Mr. Walter S. Kupper and Mr. J. R. Howlett, of New York City, to undertake an investigation of clothes moths for the purpose of gathering information which would help solve the problem of moth-proofing ordinary woolen fabrics. At that time and at present, the only original information available consisted of disconnected observations, mainly concerned with the case-forming clothes moth, *Tinea*. In connection with the study which followed, hundreds of pounds of fur and old woolen rags were purchased, the moth larvæ painstakingly picked out, and the rags then sold back or thrown away. One lot of eighteen hundred pounds of old rags was purchased at one time. From these several thousand larvæ of *Tineola* was picked out by boys employed for that purpose, and placed on test cloths which had been treated with various chemicals in the hope of finding one which would prevent moth ravages. Two trunksful of fur garments were obtained from the Salvation Army stores. Two hundred pounds of blown fur were purchased from a firm which prepares rabbit fur for the hatter's trade.

The yellow clothes moth, *Tineola biselliella*, was the only moth found in all this material during a period of four years. This seems strange, especially in view of the fact that the rag material had been shipped to New York from all parts of the country, the large bale of cloth above mentioned having come from the south and consisting of dirty cast-off clothing from that region. About three specimens of the spotted clothes moth, *Tinea*, were caught flying about the house in the Bronx, New York City, in which the study was at first carried on, but the circumstances indicated that they were adventitious, and in no way connected with the supply of *Tineola* fur of which only a few cardboard boxes were present at that time. The conclusion would seem inevitable that in the region of New York City, at least, *Tinea* is of comparatively rare occurrence and that the extensive damage which is done in connection with the fur and woolen trades is due almost entirely to the other species. Both the black and the Buffalo carpet beetles were found invariably in each supply of moth material, but in comparatively small numbers. A much larger unidentified beetle occurred in great numbers in the supply of blown hat fur and rabbit skins which had their source in Australia.

Life History.—Mature moths were found

emerging from cocoons in the fur material first studied in June and July, 1913. These were caught and placed in pairs for breeding purposes in jelly tumblers which were easily covered. The females were almost invariably larger than the males and much less active. Breeding began usually immediately after emergence from the cocoons. The males were active in pursuit, fluttering and running about the female and bringing the flexible abdomen forward until it pointed anteriorly. During copulation the moths rested with bodies in opposed directions. The abdomen of the female was always large and distended with eggs even before copulation.

Egg-laying began within twenty-four hours after breeding. Single females were found to lay from thirty to one hundred and sixty eggs, but the latter number was very exceptional and by only one unusually large moth. The usual number was between forty and fifty. The egg-laying might be completed in one day or it might continue two or three weeks. The female died when the eggs were all laid. The males might live and continue active and breeding for two or three weeks. Twenty-three days was the longest period observed. The eggs were carefully placed among the threads of the cloths and fastened by some glutinous material so that they did not readily shake off. If the cloth had a ravelled edge, the female would generally place most of the eggs deep among the loose threads.

To receive the eggs, small pieces of woolen cloth were generally used. When cotton cloth was tried experimentally, the moths did not differentiate, but laid on cotton stocking material and also on silk.

For incubation and brooding, Petri dishes were used and the egg-covered cloths were placed one in each dish. Hatching began in seven days, the larvæ emerging as millimeter-long translucent-white active caterpillars. These began to feed immediately and were then colored according to the color of the cloth used. Experiments were tried with felts of several colors and as a result larvæ could be obtained with a median streak of red, blue, green, *et al.* The dyes passed through the alimentary canal apparently unchanged, and it was always possible to determine by the excreta what material had been fed upon when there were cloths of different colors.

The larvæ behaved differently in the matter of case making. Some began immediately to spin a webbing case or sometimes a passage several times the length of the body in which they would live for a longer or shorter length of time. Woven into this "silk" tunnel were usually fibers from the material from which they were feeding. In the case of fur, the resulting case would often have the appearance of a bur with the hairs woven crossways and forming a case sometimes much thicker than long. On cloth, the case was made of shorter fibers closely attached to the cloth, thus distinguishing it from the cases formed by *Tinea* which are carried about. When a *Tineola* larva wished to change its feeding place it would either continue its gallery, sometimes for several inches, or would leave it entirely and build another when a satisfactory place was reached. As the larvæ grew to mature size, the feeding case was enlarged and changed to form the cocoon.

Other larvæ seemed to spend their time "grazing" about without ever forming more than small patches of silk if any. No conclusion was drawn as to the probable explanation of the difference. It might be that the quieter kind were eventually to form the female moths, and necessarily had less energy to spend in roaming. If this is true, it establishes another instance of the application of Kipling's law, for the larvæ which remained in cases do much more damage than the roaming kind. Moth holes usually appear as round holes, or as dumbbell-shaped slits. The latter are made by the feeding of a stationary larva, the straight slit part being cut out underneath the case, the enlarged ends being at either opening of the case. The single holes are merely the feeding places at the ends of a case without the connecting split. These stationary larvæ also use much more cloth in order to make their cases. Of course both types enter cases at the end before passing into the pupa stage.

The larval stage may be completed in about

ten weeks. It was found difficult to carry definite specific larvæ under observation in Petri dishes through the entire period, but the time was established by noting the appearance of new groups of moths in the larger stock of fur. Just what there was in the Petri-dish method of culture to hinder the larval development could not be determined. Some larvæ grew to large size, approximating maturity, others died in a few weeks, but none were certainly carried from the egg to the cocoon. Ten weeks appeared to be the shortest period in which larval growth was completed, but this is necessarily partly an estimate.

The cocoon stage lasted at the shortest two weeks. This was definitely established by observing the time at which larvæ ceased feeding, and closed their cases, and then putting such cases away for observation.

It is probable that all stages of the life history may under some circumstances be more or less indefinitely lengthened. Certainly the larval stage may. Its conclusion probably depends entirely on the obtaining of a sufficient amount of food, and may probably last several months, as over winter for example. Winter stops the activities of this moth only when the temperature of the surroundings is too much lowered. In the present investigation moths were observed emerging from cocoons and larvæ were seen feeding during all months of the year. Breeding experiments were not attempted during the winter but there seems no reason to suppose they would not have been successful and that egg-laying would also have occurred.

Remedies for Moths.—A summary of results along this line may be interesting.

Remedies intended for the flying-moth stage are worse than useless. So-called repellants such as tobacco, cedar, did not repel or harm the moth in any stage. The imago stage is the most delicate of all, but it could be placed in a small closed tumbler with burning tobacco with no apparent injury. Cloth soaked in odoriferous substances for the purpose of repelling them was made the recipient of eggs as readily as untreated cloth. As already noted, the moth laid eggs as readily on cotton and silk as on wool although neither of these was used as food by the larvæ.

Any method of attack must be directed toward the larval stage to be effective. Camphor and napthalene in closed places kill all stages. The egg and larvæ turn from whitish to a yellowish brown in color; the larvæ cease activity almost immediately. No gaseous poisons were tried but undoubtedly the common ones would be effective. Kerosene and gasoline fumes were not effective.

The main method of attack in this case was directed toward poisoning the larvæ through their food. The problem was to find some poison which could be placed on cloth and serve to kill larvæ feeding on it before they could do material damage. At the same time it must not be harmful to human beings, or if harmful in posse, must be insoluble. If baby wants to chew mother's dress or its woolen blanket, it must be able to do so with impunity. After about four years of nearly continuous investigation, during which several chemists were cooperating, the problem was finally dropped. Numerous compounds were used in tests but the larvæ proved singularly immune. Larvæ placed in Petri dishes with a piece of cloth soaked in corrosive sublimate as well as other common poisons, ate of the cloth as shown by the color of their alimentary canal and the fæces, but lived on for weeks apparently uninjured. Some few substances were found which did appear to have some result but not enough to justify adopting them as the basis of a moth-proofing process.

The problem still seems to be possible, but the solution is not apparent. After the substance is found, there still remains the overcoming of the objections of the tailors and clothing manufacturers, some of whom consider clothes moths among their best friends.

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A CHROMOSOME DIFFERENCE CORRELATED WITH SEX DIFFERENCES IN SPHÆROCARPOS

The chromosome group found in the cells of the female gametophyte of *Sphærocarpos Donnellii* contains one large element which

considerably exceeds both in length and in thickness any of the older chromosomes. The chromosome group of the male gametophyte contains no element similarly distinguished by its size; on the other hand, the male possesses a very small chromosome which seems not to correspond in size to any element in the female.

The other chromosomes in the cells of either sex have the form of slender rods; there are noticeable differences in length between those of each group. The bending and not infrequent overlapping of the ends of the chromosomes place difficulties in the way of an exact determination of their number; but, subject to modification by further study, it may be said with reasonable assurance that the chromosome number for each sex is eight. As to seven of the eight, the chromosomes of the male seem to resemble those of the female; but the eighth chromosome of the female is probably corresponding to it in the male is the the large one already referred to, and the one very small chromosome.

Of the two spindles formed in each spore mother cell at the time of the homœotypic division, one shows a large body which is sometimes plainly two-parted; no element appears on the other spindle that approximates in size this large chromosome. It has been reported that in at least one species of *Sphærocarpos* two of the spores of each tetrad develop into male plants and the other two into females. Observations which I have made, although as yet in limited number, indicate that the same rule holds for *S. Donnellii.* The cytological results here reported seem to show that in consequence of the chromosome distribution in the reduction divisions two of the four spores derived from a single mother cell receive each a large chromosome (and seven of smaller size), and these spores develop into female plants; and that each of the other two spores receives a small chromosome instead of the large one, and, on germination, gives rise to a male plant.

The resemblance between this history and that of the chromosomes of certain insects, such as *Lygæus* and *Euschistus,* which possess a large X- and a small Y-chromosome, is obvious. It is too early to conclude that the particular chromosomes with respect to which the male and female gametophytes of *Sphærocarpos* differ are the bearers of definite sex-determining factors; but it seems not unlikely at least that the greater size and vigor of growth of the female gametophyte are associated with the greater amount of chromatin that its cells contain.

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THE AMERICAN ASTRONOMICAL SOCIETY

THE twenty-first meeting of the society was held August 29 to 31 at the Dudley Observatory, Albany, N. Y., about ninety members and visitors being present. The arrangements for the meeting were admirably carried out by the host, Professor Benjamin Boss, acting also for the trustees of the Dudley Observatory and the department of meridian astrometry of the Carnegie Institution of Washington. The activities included an excursion to Saratoga Lake and a visit, at the close of the meeting, to Vassar College and its observatory.

Various committee reports and items of business were considered by the society, among others the question of the daylight saving movement, and when an informal expression of opinion was called for, the vote stood

In favor of daylight saving.....	18
Opposed to the plan	22
Neutral	6
	46

Another matter in the same connection, which would affect only astronomers, was a proposal coming from England that the astronomical day begin at midnight instead of at noon as at present. A test vote showed that a large majority of the members present were opposed to the change, but after some parliamentary procedure it was agreed to refer the matter to a committee to make a report back to the society.

Officers were elected for the ensuing year as follows:

President—Edward C. Pickering.
First Vice-president—Frank Schlesinger.
Second Vice-president—W. W. Campbell.
Secretary—Philip Fox.
Treasurer—Annie J. Cannon.

Councillors—Ernest W. Brown, Edwin B. Frost, J. S. Plaskett, Joel Stebbins.

The next meeting of the society will be held at the Harvard Observatory about September 1, 1918.

Following is the list of papers presented at the meeting, the abstracts of which are published in *Popular Astronomy:*

Sebastian Albrecht: On the variation in spectral type of the fourth-class variable star *l Carinæ.*

S. I. Bailey: Note on the variable stars in the globular cluster *Messier 15.*

L. A. Bauer: A brief statement of the work of the Committee on Navigation and Nautical Instruments of the National Research Council.

R. R. Candor: A mechanical device for interpolation.

Annie J. Cannon: Distribution of light in stellar spectra.

J. B. Cannon: Note on two spectroscopic binaries.

W. A. Conrad: Note on a possible explanation of erratic jumps in clock rates.

R. H. Curtiss: Spectra of *Nova Geminorum No. 2* and other stars.

Ralph E. De Lury: A new form of spectrocomparator.

A. E. Douglass: The Steward Observatory of the University of Arizona.

A. E. Douglass: An optical periodograph.

Raymond S. Dugan: On the eclipsing variable *R Canis Majoris.*

W. S. Eichelberger: Eccentricity and longitude of perisaturnium of the orbits of *Enceladus, Tethys* and *Dione.*

W. S. Eichelberger: The obliquity of the ecliptic from the Sun observations made at the U. S. Naval Observatory, 1903–1911.

W. S. Eichelberger: The refraction at Washington.

W. S. Eichelberger and F. B. Littell: Day observations minus night observations.

W. S. Eichelberger and H. R. Morgan: Comparison of Washington right ascensions with those of Newcomb, Auwers, Boss, Hedrick and Poulkowa, 1905.

W. S. Eichelberger and H. R. Morgan: Comparison of Washington declinations with those of Newcomb, Auwers and Boss.

George E. Hale: The best service of astronomers in time of war.

W. E. Harper: Notes on some spectroscopic binaries.

C. C. Kiess: On the presence of rare earths in *a Canum Venaticorum.*

E. S. King: Some recent work in photographic photometry.

Jacob Kunz and Joel Stebbins: Photo-electric observations of new variable stars.

C. O. Lampland: Measures of position of the nucleus of the great nebula in *Andromeda.*

C. O. Lampland: Recent observations of *Nova Persei 1901.*

C. O. Lampland: Photographic observations of the variable nebulæ N.G.C. 2261 and N.G.C. 6729.

F. B. Littell: Variation of latitude at the U. S. Naval Observatory.

W. F. Meggers: Photography of the solar spectrum.

Paul W. Merrill: Photography of the extreme red and infra-red portions of stellar spectra.

Joel H. Metcalf: A comparison of an 8-inch doublet with a 10-inch triple anastigmatic lens.

G. H. Peters: The photographic telescope of the U. S. Naval Observatory.

E. C. Pickering: Variation in light of asteroids.

W. F. Rigge: The total solar eclipse of June 8, 1918, as visible in the United States.

Luis Rodés: Direct application of Wulf's electrometer for recording the time sent by wireless telegraphy, and its connection with the potassium photo-electric cell to register the duration of totality in a solar eclipse.

H. B. Rumrill: A plea for the small telescope.

H. N. Russell: The masses of the stars.

H. N. Russell: On the calculation of the orbits of visual binaries.

H. N. Russell: New double star orbits.

F. H. Seares, A. Van Maanen and F. Ellerman: Location of the sun's magnetic axis.

H. T. Stetson: Some recent improvements in thermo-electric apparatus for photographic photometry.

Frank Schlesinger: Determination of stellar parallaxes at the Allegheny Observatory.

V. M. Slipher: Observations of the aurora spectrum.

V. M. Slipher: Spectrographic observations of star clusters.

R. Trümpler: Preliminary results on the constitution of the *Pleiades* group.

David Todd: Weather prospects along the central line of total eclipse, 1918, June 8.

A. Van Maanen: Discussion of the Mt. Wilson parallaxes.

F. W. Very: On a possible limit to gravitation.

Joel Stebbins,
Acting Secretary